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MS 79 (1973) (English): SPECIFICATION FOR THE STORAGE AND TRANSPORT OF GREEN BANANAS

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MALAYSIAN STANDARD

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SPECIFICATION FOR THE STORAGE AND TRANSPORT OF GREEN BANANAS

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Committee representation

The Agricultural Industry Standards Committee under whose supervision this Malaysian Standard was prepared, comprises representatives from the following Government Ministries, trade commerce and manufacturer associations and scientific and professional bodies.

Federal Agricultural Marketing Authority
Federation of Malaysian Manufacturers
Lembaga Kemajuan Tanah Persekutuan
Malay Timber Industry Association
Malayan Edible Oil Manufacturers' Association
Malayan Medical Association
Malayan Tobacco Manufacturers Association
Malaysian Agricultural Research and Development Institute
Malaysian Pineapple Industry Board
Malaysian Plywood Manufacturers' Association
Malaysian Scientific Association
Ministry of Agriculture and Fisheries (Division of Agriculture)
Ministry of Agriculture and Fisheries (Division of Fisheries)
Ministry of Agriculture and Fisheries (Division of Food Technology)
Ministry of Education (College of Agriculture Malaysia)
Ministry of Primary Industries
Ministry of Technology, Research and Co-ordination of New Villages
(Department of Chemistry)
Ministry of Trade and Industry
National Chambers of Commerce of Malaysia
Oil Palm Growers Council of Malaya
Rubber Producers' Council of Malaya
Rubber Research Institute of Malaya
Timber Trade Federation of Malaysia
University of Malaya

The Technical Committee on Fruits which prepared this Malaysian Standard consists of representatives from the following member organisations:

Consumer Association

Federal Agricultural Marketing Authority

Federal Industrial Development Authority

Malayan Agri-Hoticultural Association

Malayan Pineapple Industry Board

Ministry of Agriculture and Fisheries (Department of Agriculture)

Ministry of Agriculture and Fisheries (Division of Food Technology)

Ministry of Defence

Ministry of Health (Institute for Medical Research)

National Chambers of Commerce of Malaysia

University of Malaya (Faculty of Agriculture)

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FOREWORD

These Malaysian Standard Recommendations have been prepared by the Technical Committee on Fruits under the authority of the Agricultural Industry Standards Committee.

The export of bananas to overseas markets involves an element of risk because of the highly perishable nature of the fruit. To reduce this element of risk involved in the trade, it is essential to establish a highly efficient and integrated marketing system with the aim of supplying the market with bananas of acceptable quality.

Bananas shall be harvested at the stage of maturity found to be most suitable for storage and transport to the respective consumer countries.

An important problem in the shipment and storage of bananas is the wastage due to fungal invasion. It is important to recognise that any damaged part or wound on the fruit would provide an entry for the invading fungi. To minimise this wastage in shipment, it is necessary to ensure that the harvesting, handling and transport operations are carried out with care to avoid unnecessary mechanical damage to the fruit.

These Malaysian Standard Recommendations aim to provide the producer/exporter with the essential guidelines for the successful trading of green bananas.

These Malaysian Standard Recommendations are based mainly on the ISO Recommendation, Ref. No : ISO/R931 - 1969 (E), for green bananas - 'Guide to storage and transport'.

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SPECIFICATION FOR THE STORAGE AND TRANSPORT OF GREEN BANANAS

1. Scope

1.1 These Malaysian Standard Recommendations describe conditions for the successful keeping, with or without cooling of green bananas, *Musa sp.*, in the preclimacteric phase during storage before transport from the place of production to the place of consumption and during maritime transport.

2. Definitions

2.1 The term **bunch** means the fruit bunch regardless of its size.

2.2 A **finger** means an individual fruit.

2.3 The term **hand** refers to a cluster of fingers or fruits.

2.4 The **stalk** is the axis of the inflorescence or bunch.

2.5 A banana is said to be in the **preclimacteric phase** when the process of ripening has not yet been initiated.

2.6 The term **cultivar** is used to indicate that the varieties of bananas entering into commerce are cultivated varieties.

2.7 The **air-circulation ratio** is defined as the ratio of the volume of air per h passed by the fans, to the volume of the empty chamber.

2.8 By the **rate of air change** is meant the ratio of the volume of outside air introduced into the refrigerated enclosure in 1 h, to the volume of the empty enclosure.

2.9 By **critical temperature** is meant the temperature at or below which, for a given period of storage, physiological disorders are produced, that is, it is not possible to obtain normal ripening when the product is taken out of storage.

3. Conditions of harvesting and putting into storage

3.1 Harvesting

The degree of maturity of the banana shall be determined as a function of the criteria listed in 3.1.1 and the number of days elapsing between harvesting and putting into the ripening room. It shall not be too advanced, in order that the bananas may remain in the preclimacteric phase until they are put into the ripening room in normal conditions of transport.

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The criteria for harvesting are dependent on the cultivar grown and also the distance between the producer and the consumer.

3.1.1 *Criteria for harvesting*

The criteria for harvesting which should generally be used in practice are:

(a) The fullness of the fruit, which is a dimensional criterion,

(b) The colour of the flesh, which is a criterion of the physiological state and is assessed by means of a conventional colour scale enabling a numerical value to be obtained.

(c) The firmness of the flesh, which is a criterion of the physiological state and is measured by means of a spring penetrometer (with a cylindrical end 4 mm in diameter, and a spring which is reduced in length by 100 mm under a force of 2.5 kgf).

3.1.2 *Examination for degree of maturity*

Examination for the degree of maturity of a bunch of bananas shall be carried out by using the representative fruit found in that part of the bunch which is in the most advanced state of maturity, namely, in the first or second hand reckoned from the big end of the stalk. The representative fruit is the centre fruit of normal shape in the inside row of the second hand.

3.2 Quality characteristics for storage and transport

3.2.1 The bananas shall be free from signs of attack by fungi, bacteria, insects or animal pests, and free from parasites. They shall not be injured by fungal or physiological diseases.

3.2.2 In order to avoid the development of fugal diseases during storage, the fruit shall be clean. It shall not be stained with sap.

3.2.3 The bananas shall be free from evident marks or rubbing, scrapping, bruising, discoloration, sunburn or sprayburn.

3.2.4 Where the bananas are to be supplied in hands or portions of hands, the latter shall show a smooth cut, where detached from the stalk. Each hand or portion of hand shall be free from portions of stalk.

3.2.5 Unless otherwise specified by the purchaser, each portion of hand shall contain 8 or more fingers.

3.2.6 The neck of the bananas shall be strong. Bananas with weak necks shall be rejected.

3.2.7 Where the bananas are to be supplied in bunches with the stalk intact, the latter shall not show marks of sunburn and its two cut ends shall be fresh, clean, and without smear, tears or breaks.

3.2.8 The two ends of the stalk shall be cut such that they do not protrude beyond the lengths agreed on between the vendor and the purchaser.

3.3 Post-harvest anti-fungal treatments:

To minimise the damage done by fungi to bananas in shipment and storage the following treatments are recommended:

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3.3.1 *For bananas to be marketed in bunches*:

The cut ends of the stalk shall be smeared with a commercial fungicidal paste permitted by the importing country.

3.3.2 *For bananas to be marketed in hands or portions of hands*:

The fruit shall be washed in running water to remove debris and sap exuding from the cut cushion. The washed fruit shall then be dipped in a solution/suspension of a fungicide permitted by the importing country. The treated fruit shall be drained and packed into cartons while still wet.

3.4 Putting into storage

3.4.1 The bananas shall be put into cold storage for long journeys, or into ventilated storage for short journeys, as soon as possible after harvesting. The interval between cutting the bunch and putting it into a refrigerated or ventilated enclosure (prerefrigeration room, storage room or ship's hold) shall be less than 24 hs if possible, and shall not in any case exceed 48 h.

3.4.2 After harvesting and packaging, if the bananas are awaiting land transport to the port of embarkation, they shall be put in the shade and in a well-ventilated place.

3.4.3 At the port of embarkation, the waiting time of lorries for wagons loaded with bananas, before transfer to the ship's holds, shall be reduced to the minimum and the vehicles shall be in the shade.

4. Packaging and marking

4.1 Packaging

Green bananas shall be packed in the following way:

(a) In hands or portions or hands packed in corrugated paper boxes of minimum 12 kg net weight each; or

(b) In bunches, each individual bunch packed in bags of transparent polyethylene perforated with three-quarter-inch holes three to four inches* paper.

*1 inch = 2.54 cm

4.2 Marking

Each box or bag shall be marked to give the following information:

(a) Name of the cultivar;

(b) Name and address of the producer and/or exporter;

(c) Net weight in kilogrammes;

(d) Code number indicating the date of harvesting; and

(e) Country of origin.

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5. Sampling

5.1 Representative samples of bananas shall be drawn as prescribed by the relevant clauses of the Malaysian Standard MS 78 'Method of sampling fresh fruits'.

6. Optimal conditions of storage and transport (with cooling) in shipment

6.1 Ripening

Ripening of the bananas during storage shall be minimised by all possible means. Ripening is accompanied by an increase in the production of carbon dioxide and by the production of ethylene. Ethylene is liable to trigger the ripening of the adjacent bananas.

6.1.1 Experience in storage shows that with an efficient ventilation system, ensuring continuous sweeping of all parts of the load by the air circulating in the holds of the bananas vessel, and with continuous changes of fresh air, carbon dioxide and ethylene can be removed without any action on the adjacent fruit.

6.1.2 The occurrence of an abnormal percentage of ripe bananas on discharge of the banana vessel arises from three causes which shall be avoided:

(a) Loading of bananas at too advanced a stage of ripeness;

(b) Defects of ventilation;

(c) Defects in the refrigeration plant.

6.2 Refrigerated storage and transport of green bananas include two phases: cooling and storage.

6.3 Cooling

The temperature of the bananas (usually 25°C to 30°C) on loading into the ship's holds, shall be lowered to the practical storage temperature.

6.3.1 *Rate of cooling*

Cooling of the bananas shall be carried out as rapidly as possible. It depends on the following factors:

(a) The power of the refrigeration plant (of the order of 700 to 800 frigories* per h per tonne** of bananas). With a central refrigeration plant, and loading of the banana vessel divided between two days, it is possible to apply the whole of the refrigerating power of the vessel to the first half of the cargo from the start of refrigeration and to dispose of more than 1000 frigories per h per tonne of bananas;

(b) The air circulation ratio in each ventilation section. An air circulation ratio of 80 to 100 per ventilation section (collection of compartments, usually two, depending on the same fan or fans) is recommended;

(c) The uniformity and speed of the air circulation across the load. The rate of air change recommended is one change per h, but is may be reduced to half a change per h during cooling in order not to retard this;

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(d) The surface of each package in contact with the cooling air;

(e) The efficiency of ventilation (effect of external and internal short-circuits of the air). The ventilation system recommended is that with vertically ascending or descending air in series (two compartments superimposed and separated by a slatted floor), with a uniform distribution of air over the surface at the suction side or the delivery side. Each compartment is traversed by all the air delivered by the fans and consequently its air circulation coefficient is double that of the ventilation section;

(f) The mode of packaging (polyethylene bags or corrugated paper boxes);

(g) The method of storage (compact or in stacks);

(h) The method of loading the banana vessel (continuously or in 2 days with an interval of 12 h at night).

6.4 Storage in shipment

6.4.1 *Temperature*

Throughout the period of maritime transport, after cooling of the bananas, it is necessary to ensure that the practical storage temperature of the delivery air is maintained at the value adopted. This is achieved by adding to the critical storage temperature a safety margin which which shall be + 0.2ºC to 0.5^{o} C for a refrigeration plant using brine, and +0.5^{o}C to + 0.7^{o}C for a direct expansion plant.

6.4.1.1 The critical temperature for bananas is not constant, its value depending on the cultivar considered and the duration of the maritime transport.

* 1 frigorie is approximately equivalent to 50 Btu per min.
1 frigorie = 4.185 5kJ/h
** 1 tonne (metric ton) = 1000 kg 1 tonne = 2 204.6 lbs

6.4.1.2 The following values are given as indications only:

Cultivar	Period of storage days	Critical temperature degree Celsius
Pisang embun (Gros michel)	12	12
Pisang masak hijau (Cavendish type)	11 or 13	14.4
Pisang serendah (Dwarf cavendish)	16	12

6.4.2 *Relative humidity*

When the cooling of the bananas is completed, the relative humidity of the air entering the banana compartments shall lie between 85 and 90% throughout the period of maritime transport.

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6.4.3 *Air circulation*

The air circulation ratio shall be reduced to 40 to 50 per ventilation section after the end of the cooling period.

6.4.4 The rate of air change recommended is one change per h.

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